PRESENT SITUATION OF RICE DOUBLE CROPPING IN THE MUDA IRRIGATION AREA, MALAYSIA

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ABSTRACT

The Muda area which covers 96,000 ha is Malaysia's largest double cropping region, accounting for 34% of the nation's irrigated rice area. Double cropping which was introduced in 1970, was readily adopted by the region's farmers, and technological advances have been rapid by Malaysian standards. The region's agriculture is heavily mechanized in the case of tillage and harvesting while the labor-saving technique of direct seeding has spread to 65% the area.

The period of high yields exceeding 4.5 t/ha in 1979-81 was followed by serious problems of pest and disease infestation resulting in yield decline to 3.1-3.2 t/ha in 1982-84. Problems also include the proper scheduling of irrigation and farm operations to attain the maximum cropping intensity compared to the 175% currently being achieved. To overcome the inadequacy of the present infrastructure with a canal density of only 10 m/ha, a new construction program to increase the density to 35 m/ha has been initiated. This undertaking will result in a significant improvement of the water management capability at the field level and will be the basis of improved productivity in the future. Equally important for cropping stability and yield growth are the improvement of the techniques of direct seeding culture and large scale management of rice pests and diseases.

Background to double cropping in the Muda area

The Muda area is the largest of Malaysia's irrigated rice areas, and with about 96,000 ha it accounts for 34% of the country's 284,000 ha presently under double cropping. Double cropping is a comparatively recent phenomenon in the area's agricultural history, as it was introduced only in 1970 after the completion of irrigation facilities, prior to which only rainfed single cropping had been possible.

The objective of the introduction of double cropping was two-fold. First, it was seen as a means of increasing Malaysia's production of rice, the staple food of the population, for which the country had traditionally been heavily dependent on imports, (a food security objective). second, the objective was to increase farmers' income in a historically poor region of the country, (rural development objective).

Since its introduction in 1970 the spread of double cropping technology has been rapid. By 1975 about 90% of the area, which is the limit of irrigable area, was under a second crop annually, along with the universal adoption of short term rice varieties, increased use of fertilizers and agro-chemicals and significant advances in farm mechanization and labor-saving techniques in farm operations.

The historical record of the annual cropped area and yield per hectare is shown in Fig. 1. Paddy yield averaged 3.1-3.3 t/ha during the single cropping period prior to 1970 and even during this period improved short term rice varieties such as *Mahsuri* and *Malinja* were widely planted, and the usage of inorganic fertilizers was already common. The introduction of double cropping in 1970 together with the shift to improved rice varieties especially IR-5 and the introduction of a government-sponsored credit program for the purchase of fertilizers and agro-chemicals resulted in significant yield improvements to 3.6 and 3.7 t/ha in 1970, and over 4 t/ha

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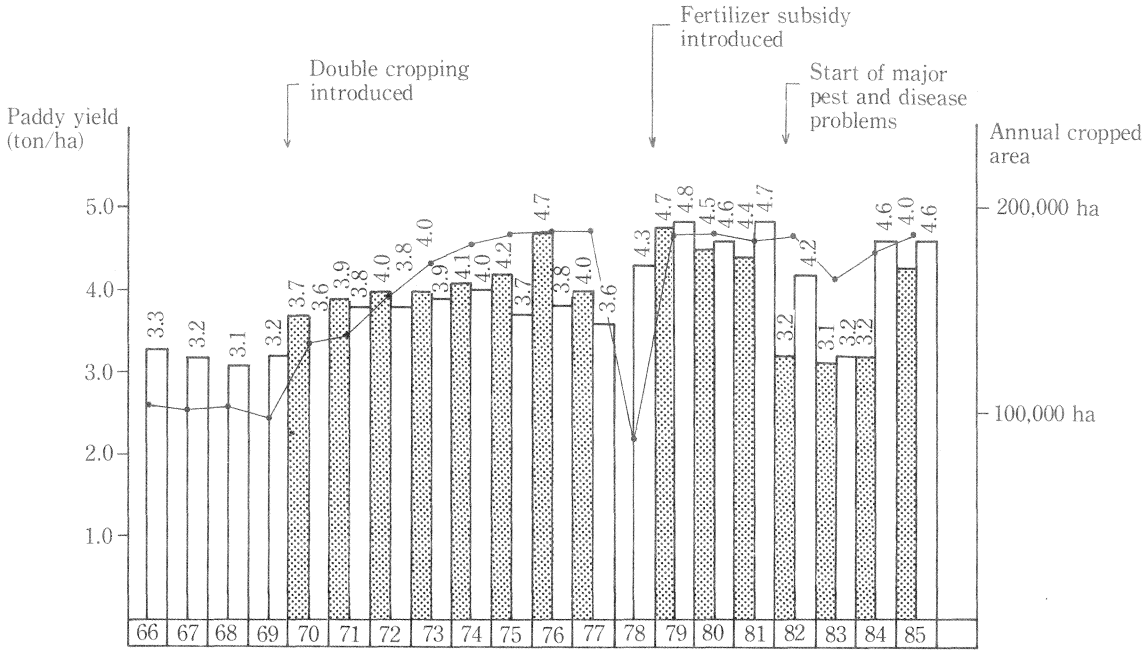

Fig. 1 Record of paddy yield and annual cropped area in Muda.

Dry (off) season yield ☐ Wet (main) season yield

Annual area cropped

in the following years. By 1975 the Muda area had almost achieved its maximum double cropping capacity and the annual rice production more than doubled from about 323,000 tons per annum prior to 1970, to 770,000 tons in 1975, mainly as a result of double cropping. Instability in double cropping was first experienced in 1978 when the entire dry season crop was cancelled owing to low water storage, followed by a period of high yields after 1979 consistently in excess of 4.3 t/ha owing to a national free fertilizer scheme. However, the last few years since 1982 have shown both low yields due to pest and disease infestation as well as declining cropping intensity, and the solution to these problems is most important for stabilizing and increasing production in the Muda area.

Status of irrigation infrastructure for double cropping

Although the Muda area has had a generally successful record of double cropping, the level of irrigation infrastructure provided at the farm level is considered to be inadequate to support modern agricultural technology which emphasizes proper on-farm water management. Under the original construction program completed in the early 1970s, the design of water distribution and drainage systems, based on standards prevailing in Malaysia at that time, involved widely-spaced irrigation and drainage canals serving irrigation blocks of about 800 ha, each and 400–500 farmers. Irrigation is effected by field-to-field flooding from canals over distances of 1,200 m to 2,000 m. Overall canal density averages 10 m/ha with only about 10% of farm lots with direct access to an irrigation canal. Further, although the Muda area is extremely flat at the macro-level, the micro-topography is quite variable with high grounds interspersed with natural depressions leading to uneven distribution of water within each irrigation block of

about 800 ha which is presently the smallest unit for systems water management. The present condition with respect to the majority of the Muda area is as follows:

1) Delays of up to 40 days in the distribution of irrigation water owing to long overland distance of water flow within each irrigation unit (about 800 ha).
2) Excessive or insufficient amount of water in fields depending on the micro-topographic situation.
3) Inability of farmers to attempt proper water management according to crop needs.
4) Wastage of water as the farmers tend to wait for the whole block to be irrigated before commencing farm operations.
5) Wide staggering of planting activities among farmers and poor adherence to the double cropping schedule. This accounts for the water wastage problem as the irrigation supply for the whole block has to be maintained irrespective of individual field water requirement.
6) Poor drainage with water-logged soil conditions throughout the year in considerable parts of the area causing difficulties for the trafficability of farm machinery owing to the deterioration in the load bearing capacity of the padi soil caused by permanent flooding.

In order to overcome the existing infrastructure inadequacies, a program of tertiary development was begun in 1979 and by 1987, 25,000 ha or about 26% of the Muda area will be provided with an intensive system of tertiary canals, drainage and farm roads. Under this program irrigation canal and drain density will increase to about 35 m/ha, with 80% of farm lots having direct access to a canal and drain. Every two farm lots share a common irrigation turnout and drainage outlet, thus reducing greatly the dependence on field-to-field water flow for irrigation supply and drainage. With the improved system the smallest unit of systems water management will be reduced to 15–20 ha (called an Irrigation Service Unit) and involve 10–15 farmers only. Farmers within each unit are expected to follow a common schedule of irrigation and crop cultivation. Among the benefits expected from the improved systems, apart from improved crop yields, are higher cropping intensity, orderly usage of farm machinery, effective crop scheduling and reduced consumption of water (MADA, 1977). Preliminary observations from completed blocks indicate however that although they are functioning as expected in the engineering sense, with irrigation in each unit attained within 7 days or less and drainage facilitated, the main objectives are generally not yet being achieved. Adherence by farmers to the designed planting schedules is unsatisfactory, thereby negating the benefits of speedy supply of irrigation water, wide variability in cultivation schedules even within the small irrigation units still exists, and improved management of water by farmers is generally lacking. After more than 2 years of operation no clear indication of higher cropping intensity or better yields is obtained. It would appear that closer farmer participation and cooperation among them is necessary for the benefits of tertiary development to be realized.

Factors in the determination of double cropping schedules

Stable double cropping and the maintenance of a high annual cropping intensity largely depend on the adequate supply of irrigation water, the determination of suitable cropping schedules and the adherence to these schedules by farmers. The theoretically possible annual cropping intensity as suggested by the command area of the present irrigation facilities would be about 190% but in actual practice only about 175–178% is achieved. Although the area is termed an irrigation area, only about 35% of annual irrigation requirements can be met from storage reservoirs, with the balance being met from river flow and rainfall on the padi fields. The annual inflow into the reservoirs is itself very variable, as indicated by the extremes in the 15 year record from 1970–1984 ranging from 1,033 million cubic meters in 1973 to 509 million cubic meters in 1978. Further, although the dependence on rainfall is high (33% of total water requirements), the intra-year rainfall pattern and annual quantity are also very variable. The calculated probability of meeting annual water demand is 60% (MADA, 1977).

In the early years of double cropping, water conservation was the main factor determining the annual irrigation schedule, but since 1979 two additional important factors, namely pest and disease control and an increasing problem of decline in the padi soil load bearing capacity, have been included as equally important crop scheduling criteria for long term stability of rice production.

A further complicating factor in determining the irrigation schedule and creating problems for water management in the field is the complex mixture of planting techniques practiced by the farmers. There is at present a mixture of direct seeding (dry and wet method) as well as the transplanting method in flooded fields practiced by farmers within small areas, and even within the 15-20 ha of the irrigation service units of the new tertiary system. As water requirements vary with the methods of crop establishment, scheduling of irrigation from the point of view of the area as a whole is seriously affected.

The present approach towards the establishment of an appropriate irrigation and cropping schedule for double cropping in the Muda area basically aims at achieving a fallow period of about one month beginning some time in January each year during the period of normally no or very low rainfall. This is considered important for the long term stability of double cropping for the following reasons:

1) The one month dry fallow period between crops is an important strategy in pest and disease management owing to the absence of a growing padi crop throughout the entire Muda area and it should help eradicate the sources of disease inoculum and their insect vectors, as well as other pests.
2) The dry fallow period enables the recovery of the soil load bearing capacity, which declines owing to continuous flooding.
3) No irrigation supply during this period helps in irrigation water conservation.

The general double cropping schedule presently adopted is shown in Fig. 2.

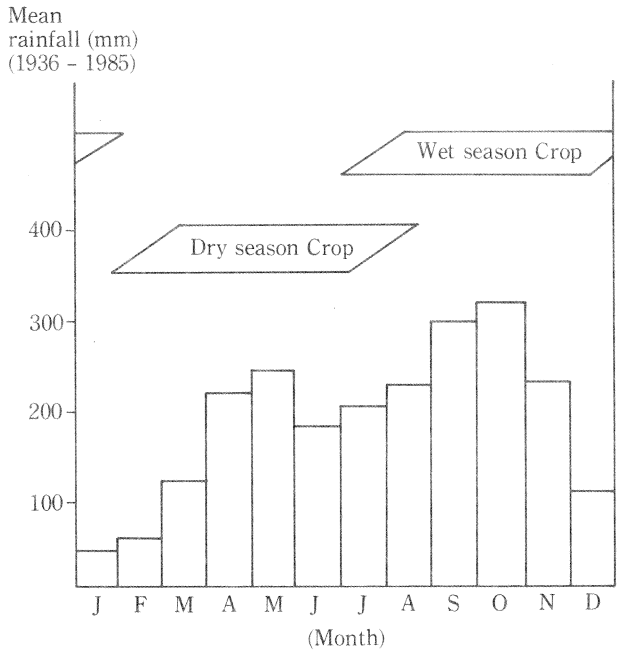

Fig. 2 Suitable cropping schedule for double cropping.

Status of farm operation and technology

The Muda area is operated by about 63,000 farm families with an average farm size of 1.5 ha, but with a wide dispersion in farm sizes. Forty two percent of all the farms are 1.1 ha and less in size while the farms over 3.5 ha in size account for 8%. Of late, farm size expansion, supported by widespread mechanization and the labor-saving practice of direct seeding has been detected. The status of production technology and farm management practices however does not vary greatly according to the farm size except for labor utilization per hectare which declines with increasing farm size (WONG, 1983).

1 Land tillage

Almost complete mechanization of tillage was attained more than 10 years ago. Owing to the generally small size of the farms, only about 10% of the farmers own tractors, typically of the 2-wheel type (WONG, 1983). The main dependence is on 4-wheel tractors up to about 65 ps usually owned by contractors who in some cases could also be larger farmers. Intensity of tractor use varies according to the crop establishment technique and field conditions. Up to three rounds of rotary tillage are practiced under conditions of soil disturbance by combine harvesters and heavy weed growth, while in case of direct seeding only a single pass of shallow rotovation under dry soil conditions may be used. The total machinery availability is presently estimated at about 6,000 2-wheel and 1,500 4-wheel tractors. The major technical problems presently encountered are bogging and poor trafficability in padi areas with a history of continuous flooding.

2 Rice varieties

All the farmers use modern varieties of medium grain length and with a maturity period of between 130 days and 140 days, with no significant varietal preference for wet and dry season crops, or between transplanting culture and direct seeding. In examining rice varieties suitable for the scheduling constraints of the Muda area, and for maximum rice production annually, NOZAKI (1984) recommends varieties with a maturation period of 125 days, and this has been incorporated into the breeding program.

3 Crop establishment

The traditional method has been transplanting of seedlings raised in nurseries but since 1979 there has been a rapid expansion of direct seeding culture, as shown in Table 1.

Techniques of direct seeding vary considerably ranging from the volunteer seedling method with shallow rotovation of dry fields to incorporate grain loss from the harvest into the soil and subsequent irrigation, to wet seeding on drained fields after thorough tillage and subsequent irrigation. In general rice yield from direct seeding is lower than that from transplanting with severe problems of weed infestation if practiced continuously. However the technique is expected to gain in popularity owing to lower production cost and labor saving (SYED AHMAD, 1986). The present situation of direct-seeding technology among farmers will need to be improved as a factor in promoting yield growth in the future.

4 Fertilizer use

At present the use of fertilizers is relatively uniform in the Muda area at the rate of 80 kg N 30 kg P 30 kg K per hectare due to the national fertilizer subsidy scheme introduced in 1979, and less than 4% of the farmers report the use of additional fertilizers over this amount. The present rates used represent a significant increase over the pre-subsidy rates of 56 N 24.6 P 5.6 K kg/ha for the dry season and 57 N 17.9 P 6.7 K kg/ha for the wet season in 1975 reported by NOZAKI and WONG (1976). This higher rate which is reflected in the generally higher yields achieved since 1979 (Fig. 1) and has also been held responsible for the increase of pest

Table 1 Trend of direct seeding in the Muda area (1977-86)

Year and season		Area direct-seeded (ha)	Percent of planted Muda area
1979	dry	32	*
	wet	181	*
1980	dry	662	*
	wet	858	*
1981	dry	4,136	4.3
	wet	6,415	6.7
1982	dry	18,575	19.4
	wet	22,100	23.0
1983	dry	34,331	35.8
	wet	27,098	28.3
1984	dry	44,398	53.0
	wet	22,714	23.1
1985	dry	28,083	30.9
	wet	29,936	31.0
1986	dry	59,402	65.1

Source: MADA Engineering Division.
* less than 1%

infestation (MARDI, 1981) may be a contributory factor to the low yields experienced since 1982. Farmers' application of fertilizer is 2-3 split application after planting and at active tillering and panicle initiation stages. Basal application before planting is rarely practiced owing to unsuitable water conditions in the field.

5 Crop protection

The Muda area had been relatively free from pests and diseases but since 1982 major problems have surfaced and several rice pests have emerged as factors contributing to the yield decline. It has been suggested that among other factors this may be due to continuous cropping which was prevalent during that time. Presently, tungro disease vectored by the green leafhopper, *Nephotettix virescens* is considered the most serious problem followed by rodents. These were the main causes of yield decline in 1982-84. Other potentially serious insect pests are *Scotinophora coarctata, Nezara viridula* and *Leptocorisa oratorious* (SYED AHMAD, 1986).

In the last few years with the dissemination of direct seeding culture weeds such as *Echinochloa crusgalli, Echinochloa colona, Leptochloa chinensis, Marsilea crenata* and *Sphenoclea zeylanica* are becoming problematic (SYED AHMAD, 1986).

Large scale management of pests, diseases and weeds is a relatively new problem for the area farmers, and crop protection is today emphasized in research and extension programs.

6 Harvesting

Presently about 95% of the area is harvested by medium-sized combine harvesters imported from Western countries. These machines are operated exclusively by contractors. Some problems have arisen with the use of such large machines (7-8 tons) in poorly drained soft soils and soil disturbance and damage to irrigation canals and structures are reported. However, efforts to introduce small lightweight combines have not been successful owing to their low rate

of work and low durability under the adverse field conditions.

Conclusion

While the Muda area has had a generally successful record of double cropping, several technical problems are presently arising which threaten the stability of the cropping intensity and yield growth. Adequate supply of irrigation water, proper scheduling of double cropping and adherence to these schedules by the 63,000 or so farmers in the area are crucial if the present theoretical maximum annual cropping intensity is to be realized. In farm practices greater emphasis must be placed on the improvement of direct seeding culture, better control of pests, diseases and weeds. The program to improve water management at the field level through the construction of new facilities presently under way has to be continued as well as the education of farmers in appropriate water management practices.

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